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HISTORY OF SCURVY IN THE INLAND OF CENTRAL EUROPE (CZECH REPUBLIC) – A REVIEW

ABSTRACT: In the history of medicine, scurvy is associated mainly with great overseas discoveries in the 15th and 16th centuries. It is estimated that about 2 million sailors died of scurvy during this period of discovery. The occurrence of scurvy in the past is therefore well mapped in coastal countries, but insufficient attention has as yet been paid to its distribution among the civilian population inland. The presented communication summarizes the available information on this disease, obtained both from literary sources and from the study of direct evidence on skeletal remains from various dated archaeological sites in the Czech Lands (Bohemia, Moravia, Silesia), located in Central Europe. The study also seeks to capture the living conditions of individuals with scurvy, with a special focus on the nutrition of the studied population. It confirms the occurrence of this disease from prehistory to modern times. The endangered group is always children between 2 and 5 years of age, which corresponds to the period when breastfeeding ends and there is a transition to a solid diet. In modern times, scurvy is recorded mainly in social institutions (orphanages, foundling homes), prisons and in armies in times of war.

KEY WORDS: Paleopathology – Scurvy – Czech Lands – Central Europe – Vitamin C – Vitamin deficiency

INTRODUCTION

Scurvy is a disease caused by a lack of vitamin C (L-ascorbic acid) for at least 160–200 days (Armelagos *et al.* 2014). The important enzyme L-gulonolactone oxidase is missing in humans. Because of this, humans cannot synthesize vitamin C from glucose in the liver like some other animals. The amount of vitamin C, therefore, depends exclusively on its dietary intake (Lapčík 2001). This vitamin is a powerful antioxidant,

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protecting tissue from the effects of free radicals. It is therefore an important component of many redox processes in the body and affects a wide range of physiological processes. It significantly supports the body's immune response, accelerates the detoxification of foreign substances and has a beneficial effect on the function of the central nervous system. It promotes iron resorption and blocks the action of carcinogens (Wheeler *et al.* 1998). In its absence, collagen molecules – the basic components of connective tissues – are unstable and unable to form normal higher structures. Vitamin C deficiency affects mainly the quality of basement membranes, blood vessel walls, ligaments, cartilage, bones, etc. (Armelagos *et al.* 2014).

The clinical manifestations of avitaminosis C are typical weakness, fatigue, loss of appetite, weight loss, diarrhoea, fever, anemia, decreased immune system, slow wound healing, bleeding from inflamed gums, tooth loss, skin bleeding, joint and bone pain (Fajfrová 2011).

Scurvy has played a very important role in the history of medicine. Its occurrence in the past is relatively well mapped in coastal and island countries, as avitaminosis C has always been considered primarily a dreaded disease of sailors. In these areas, a large number of fatal cases of scurvy have been reported in the literature, some of which are also documented by paleopathological findings (e.g. Aufderheide, Rodríguez-Martín 1998, Baron 2009, Crawford 1988, Geber, Murphy 2012, Maat 2004, Magiorkinis *et al.* 2011, Steinbock 1976). Inland, information on scurvy occurrence varies, and there are significant geographical differences (for example, there has been no mass occurrence of vitamin C deficiency in the tropical climate zone). The incidence of the disease is mainly related to the way of life in individual populations and to the social status of certain groups of the population (Morrone *et al.* 2021). Some authors, such as Delanghe *et al.* (2013), attribute the possibility of scurvy to an innate genetic predisposition. In the Czech Lands (Bohemia, Moravia and Silesia), which are located in the very heart of Central Europe (*Figure 1*), historical written sources confirm the existence of scurvy (e.g. Duchek 1873), but direct paleopathological finds of skeletons with possible manifestations of scurvy are still very rare, compared to literary sources (e.g. Krenz-Niedbala 2017, Mays 2014). The presented communication aims to document all described paleopathological findings of skeletons with manifestations of scurvy in the Czech Lands from various historical stages, and thus to enrich the knowledge about the occurrence of scurvy in Central Europe in the past. The study also seeks to capture the living conditions of individuals with scurvy, with a special focus on the nutrition of the studied population.

HISTORY OF SCURVY BASED ON WRITTEN AND ICONOGRAPHIC SOURCES

In the history of medicine, scurvy is one of the oldest diseases. The Latin name *scorbut* comes from the word *scorbutus*, which means a mouth affected by rot. One of the first medical records – the Ebers Papyrus (around 1550 BC) – mentions a mysterious sailors' disease corresponding to a vitamin C deficiency. As a therapy, he recommends the fruits of a sacred tree – *Ficus sycomorus*. Among historical figures, a number of world-renowned physicians described the possible manifestations of scurvy. Their writings included a summary of all medical knowledge at the time. These include Hippocrates (*460–†377 BC), Aristoteles (*384–†322 BC), Aulus Cornelius Celsus (*25 BC–†50 AD), Claudius Galenus (*129–†200 or 216 AD?), Paulus of Aegina (*625–†690 AD) and Avicenna (*980–†1037 AD). The etiology of this disease has not been known for a long time, although recommended

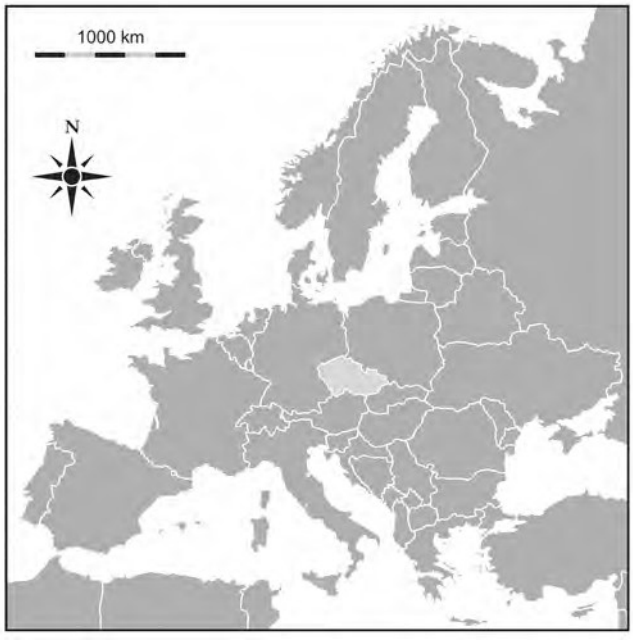

FIGURE 1: Map of the European continent. The position of the Czech Republic in Central Europe is marked in light gray (graphics by Jana Vachová).

treatments have mostly included herbal extracts or foods rich in vitamin C (Magiorkinis *et al.* 2011, Still 1935).

In the historical context, however, scurvy is mainly associated with the 15th and 16th centuries, a period of great overseas discoveries, when European sailors lacked vitamin C-rich food on their long voyages. An estimated 2 million men died of scurvy during this period of discovery (Price 2017). Sailors feared scurvy more than storms, shipwrecks and unexpected battles. For example, more than half of the crew of the Portuguese sailor Vasco da Gama (*1469-†1524) died on a voyage from Lisbon to India (Aufderheide, Rodríguez-Martín 1998). Fernão de Magalhães (*1480-†1521) also suffered enormous losses in the lives of his sailors on his journey around the world (Burnby, Bierman 1996). On the most important voyage of discovery to the shores of America in the years 1492-1493 undertaken by Christopher Columbus (*1451-†1506), scurvy was avoided. Columbus's storekeeper, Amerigo Vespucci (*1454?-†1512), was responsible for securing a sufficient amount of jam for the crew (Armelagos *et al.* 2014, Baron 2009, Carpenter 1986, Maat 2004, Pimentel 2003). However, on Columbus's second voyage to the New World, scurvy was shown in the sailors according to paleopathological findings. Tiesler *et al.* (2016) found possible scurvy changes on the skeletons in the cemetery of La Isabela (the first European city on the American continent founded by Christopher Columbus in 1494).

Various medications have been used to treat scurvy. For example, in 3000 BC, the Chinese used sprouted plants to treat scurvy, much like the Phoenicians did later. The French Captain Jacques Cartier (*1491-†1557), considered as the "discoverer of Canada", successfully treated his sailors with a pine needle decoction on the advice of the ancient Indians. The English Admiral James Lancaster (*1554-†1618) observed the antiscorbutic effect of citrus juice on his sailors and ordered a regular supply of oranges and lemons for crews of the British Navy. The English military surgeon John Woodall (*1570-†1643), in his work "The Surgeon's Mate", also advised citrus fruits to be eaten to combat the formation of scurvy. However, experience of foods rich in vitamin C remained untapped for 200 years. It was only thanks to the Scottish ship's physician, James Lind (*1716-†1794), that the use of citrus in the fight against scurvy became widely known. He conducted the first clinical trial to monitor the effects of citrus treatment on sick sailors. In 1753, he published a treatise on scurvy, in which he recommended citrus in its treatment without, however, revealing the true cause (Baron 2009, Burnby, Bierman 1996, Durzan 2009, Pimentel 2003).

In addition to sailors, poor nutrition in the past also affected the health of soldiers during long military campaigns. For example, in Julius Caesar's (*100 BC-†44 BC) army, scurvy was considered a highly feared enemy. The Roman General and writer Plinius Gaius Secundus (*23-†79AD) also described how bleeding from the gums, weakness, limb pain and inability to walk occurred in the soldiers in 47 AD after a two-year campaign against the Teutons. These typical symptoms of scurvy were treated at the time by consuming a plant called *Herba britannica*, which was probably either the herb now known as *Inulla britannica* or a variety of sorrel (genus *Rumex*) containing vitamin C (Magiorkinis *et al.* 2011, Still 1935).

Scurvy was not as common a disease among the people living on land as it was among sailors and soldiers. It afflicted people especially during wars and natural disasters accompanied by famine. For example, Geber and Murphy (2012) describe a high incidence of scurvy among the civilian population during the great Irish famine in the second half of the 19th century.

HISTORY OF SCURVY IN THE CZECH LANDS ON THE BASIS OF LITERARY AND ICONOGRAPHIC SOURCES

The Czech Lands (Bohemia, Moravia and Silesia) are located in the center of the European continent surrounded by the mainland (*Figure 1*). They lie in a temperate climate, where winter weather with a lack of fresh fruit and vegetables usually lasts no longer than about three to four months. Therefore, in terms of the possible occurrence of scurvy, spring was especially risky for the development of avitaminosis. During the historical stages, however, the weather was never completely stable, wet summers alternated with catastrophic droughts, and sometimes floods. The result was crop failure and possibly famine, especially among the poorest sections of the population (Svoboda *et al.* 2003). Famines also accompanied war events, of which there were quite a few throughout history in Central Europe.

Knowledge about the occurrence of scurvy is insufficient from prehistoric and medieval periods. There are no written or iconographic sources about this disease in the Czech Lands, so its prevalence can only be estimated on the basis of paleopathological findings, of which there are very few to date (see the next section of this study). It was not until the 18th and 19th centuries that the "Journal of Czech Physicians" mentioned the

"epidemic of scurvy" in prisons, orphanages, foundling homes and, less often, in the urban population in poor working-class neighbourhoods. According to contemporary records, scurvy was a great rarity in Czech and Moravian villages (Duchek 1873, Nopp 1926). Direct evidence – paleopathological findings of scurvy signs on historical skeletal remains from this period – are unique to date, and do not correspond to the number of patients listed in written sources. For this reason, the presented study summarizes the well-described cases of scurvy in the Czech Lands in the past and seeks a causal link with their occurrence. It is therefore focused mainly on the eating habits of the local population in individual historical stages, and estimates the possible intake of vitamin C in commonly consumed foods and the possibilities of contemporary medical care.

PALEOPATHOLOGICAL FINDINGS OF SKELETONS WITH MANIFESTATIONS OF SCURVY IN THE CZECH LANDS

The presented work searched for documented cases of skeletons with manifestations of scurvy in paleopathological studies published to date from the Czech territory (*Figure 2*, *Table 1*). Prehistoric archaeological sites included skeletal remains from the Eneolithic period, originating from Podivín (Vargová *et al.* 2021) and from the burial ground of the Únětice culture in Kolín (Vargová, Vymazalová 2022). The medieval examples include finds from the Great Moravian Necropolis on St. Methodius Hill in Sady-Špitálky (Horáčková, Vargová 2014) and from the extinct medieval village in Southern Moravia called Trutmanice (Račanská *et al.* 2023). The most extensive osteological collection examined came from the former modern Brno Municipal Cemetery in Malá Nová Street, the present-day Antonínská Street (Vargová, Horáčková 2006).

Only those findings that corresponded to the diagnostic criteria listed in the work of Aufderheide and Rodríguez-Martín (1998), Brickley *et al.* (2020) Brickley and Ives (2006), Crist and Sorg (2014), Dewitte and Bekvalac (2011), Geber and Murphy (2012), Klaus (2014), Lewis (2004), Mays *et al.* (2006), Ortner (2003), Ortner and Ericksen (1997), Ortner and Putschar (1985), Pimentel (2003), Snoddy *et al.* (2018) Stark (2014), Steinbock (1976), Wapler *et al.* (2004), Zuckerman *et al.* (2014) and were included in the overall list. Insufficiently documented findings were excluded from the overall list of cases.

Due to the fact that scurvy is caused by a lack of vitamin C in the diet, attention was also focused on the eating

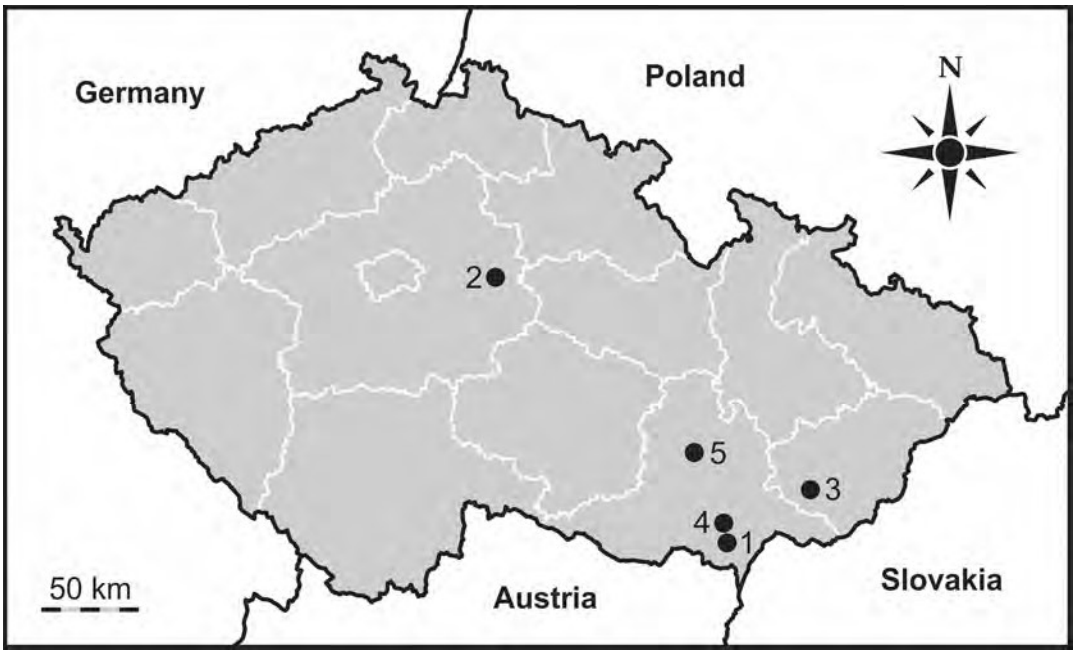

FIGURE 2: Map of the Czech Republic showing the archaeological sites. 1 – Podivín; 2 – Kolín; 3 – Sady-Špitálky; 4 – Trutmanice; 5 – Brno (Malá Nová Street) (graphics by Jana Vachová).

TABLE 1: Archaeological sites with scurvy manifestations on skeletal remains.

Site	Dating	Grave No.	Skull	Postcranial skeleton	References
Podivín	3800–3700 BC	801	Arborization of sulci arteriosi Hematoma Teeth eruption disorders Enamel hypoplasia Periodontal disease Periostosis in maxillary sinus	Rib fracture L1 vertebra fracture Left femur-periostosis	Vargová *et al.* 2021
Kolín	2000–1750 BC	4330	Arborization of sulci arteriosi Cribra orbitalia II	Periostosis on most bones	Vargová, Vymazalová 2022
Sady-Špitálky	9th–10th century	15/59	Enamel hypoplasia	Periostosis on most bones	Horáčková, Vargová 2014
		122/59	Enamel hypoplasia Periodontal disease		
Trutmanice	13th–15th century	884	Arborization of sulci arteriosi Cribra orbitalia II Pitting on orbit walls, greater wings of the sphenoid bone, zygomatic bone	Periostosis on the right tibia Harris lines	Račanská *et al.* 2023
Brno - cemetery in Malá Nová Street	18th–19th century	829	Skull was not preserved	Periostosis onmost bones	Vargová, Horáčková 2006
		867	Enamel hypoplasia	Periostosis on most bones	

habits of the individual studied historical populations. Information of this kind was obtained on the basis of a study of archaeological sources (Ernée *et al.* 2007, Galuška 1996, Piačková, Trampota 2020). Further findings were drawn from analyses of animal skeletons with traces of kitchen processing (Páral, Pyško 2011).

Paleobotanical research provided information on the relevant period vegetation as a possible source of vitamins (Kočár, Dreslerová 2010). Isotopic analyses (Kaupová 2016, Nývltová Fišáková 2017, 2022) and the study of enamel microabrasion (Jarošová 2007, 2016) also had a significant informative value on the composition of the food of the examined individuals in the given period. Cookbooks that appeared in the Czech Lands as early as the 15th century were written sources of information on eating habits of the Modern Age (Beranová 2007, Vargová *et al.* 2010).

To estimate the risk of scurvy, it was also necessary to determine the optimal daily requirement of vitamin C (depending on sex, age and current physical condition - *Table 2*, Institute of Medicine (US), 2000) and also to take into account the amount of vitamin C contained in the most commonly consumed foods (*Tables 3-4*). These data often differ in the literature, so the Tables (*Tables 2-4*) show the average values, compiled on the basis of the work of Ahmad *et al.* (2018), Kizlaitis *et al.* (1962), Lee *et al.* (2007), Salmenperä (1984), Steinhauser (2000), Unger-Göbel (1999), Wood (2017) and in the internet databases of public specialized institutes in the US (U.S. Department of Agriculture, 2019), Denmark (National Food Institute, 2019) and Czech Republic (Czech Centre for Food Composition Database, 2020).

Podivín

The oldest investigated burial ground from Podivín (*Figure 2*) was dated by the radiocarbon method to the Eneolithic period (3800–3700 BC). The small

TABLE 2: Daily recommended amount of vitamin C.

Daily recommended amount of vitamin C in individual age categories and sexes		
Age category	**Amount of vitamin C**	
	Male	**Female**
0–6 months	40 mg	
7–12 months	50 mg	
1–3 years	15 mg	
4–8 years	25 mg	
9–13 years	45 mg	45 mg
14–18 years	75 mg	65 mg
19–30 years	90 mg	75 mg
31–50 years	90 mg	75 mg
51–70 years	90 mg	75 mg
over 70 years	90 mg	75 mg

Daily recommended amount of vitamin C in individual age categories in pregnant females	
Age category	**Amount of vitamin C**
14–18 years	80 mg
19–30 years	85 mg
31–50 years	85 mg

Daily recommended amount of vitamin C in individual age categories in breastfeeding females	
Age category	**Amount of vitamin C**
14–18 years	115 mg
19–30 years	120 mg
31–50 years	120 mg

osteological group included the skeletal remains of five people (a 7- to 8-year-old child, two adult males and two females). The skeleton with possible scurvy manifestations (grave no. 801) was that of a 20- to 25-year-old male (prevalence of scurvy – 20%). These manifestations included the richly branched grooves of the meningeal artery, minor depressions on the bones of the cranial vault and an ossified epidural hematoma in the form of a multiplied diploe on a thickened frontal bone (*Figure 3*). Dental stigmas included enamel hypoplasia, dental eruption disorders (persistence of milk molars) and signs of inflammation of the dental apparatus (periodontal disease). Another symptom was a deep groove and lodgment of newly formed bone tissue in the right maxillary sinus along one of the branches of the maxillary artery. Healed fractures were noted on the 1st lumbar vertebra and rib fragment. There was also an ossified hematoma on the left femur, as there

FIGURE 3: A hypertrophic diploe is visible on a fragment of a flat bone of the skull. These are the remains of an ossified epidural hematoma (male 20–25 years; site Podivín-Rybáře; 3800–3700 BC; grave No. 801; photo by Jana Vachová).

was also new bone tissue formation. All described pathological changes on the examined skeleton were evaluated as symptoms of scurvy experienced in childhood.

In this context, the way of life of this small sample of the population was also interesting. Although agriculture already predominated in the Eneolithic period in the Czech Lands, the studied group of people from this locality probably subsisted mainly on hunting wildlife and collecting plants (Vargová *et al.* 2021). The isotopic analysis from bone samples (Nývltová Fišáková 2017) and the microabrasion of teeth (Jarošová 2016) also revealed that these individuals mainly consumed meat. The finding of a flat stone arrow in one of the graves (H 803) also testifies to this. It was probably the tip of a spear, a weapon that was commonly used in hunting.

Due to the fact that Podivín is located near the Thaya River and floodplain forests, it can be assumed that the main source of livelihood was mainly fishing and hunting forest animals. In the spring and summer months, it also included the collection of plants and forest crops. There is not enough information from archaeological research about the type of plant food in this locality. However, for example, common hogweed (*Heracleum sphondylium*), which was commonly consumed in Ukraine and Russia, is typical for the floodplain forests (Beranová 2007). According to the formation of enamel

TABLE 3: Vitamin C content in animal foods. ab-after birth; m-month.

Nutrient	mg/100g	Nutrient	mg/100g	Nutrient	mg/100g	Nutrient	mg/100 ml
pork	0.78	**pork liver**	22.58	**chicken egg-white**	0.10	**breastmilk 0–1 m. ab**	6.18
beef	0.21	**beef liver**	18.76	**carp**	1.30	**breastmilk 2 m. ab**	5.91
mutton	0.33	**chicken liver**	22.98	**pike**	3.07	**breastmilk 4 m. ab**	4.97
horse meat	0.65	**chicken heart**	3.47	**trout**	1.28	**breastmilk 6 m. ab**	4.68
deer meat	0.00	**chicken stomach**	1.85	**cow's milk**	1.10	**breastmilk 9 m. ab**	4.46
rabbit meat	1.50	**beef kidneys**	11.36	**goat's milk**	1.53	**breastmilk 12 m. ab**	4.14
chicken	0.38	**pork kidneys**	13.48	**sheep's milk**	4.23		

TABLE 4: Vitamin C content in nutrients consumed in the past in the Czech Lands.

Nutrient	mg/100g	Nutrient	mg/100g	Nutrient	mg/100g
blueberries	22.80	**white cabbage**	42.85	**horseradish**	141.90
cranberries	13.00	**onions**	7.71	**boletus**	2.85
pears	4.99	**carrots**	6.10	**leccinum mushrooms**	7.00
apples	8.29	**tomatoes**	20.81	**barley flour**	0.00
strawberries	54.66	**spinach**	48.52	**buckwheat flour**	0.00
raspberries	25.17	**peas**	27.53	**wheat flour**	0.00
potatoes	20.33	**lentils**	3.50	**rye flour**	0.00
asparagus	5.60	**garlic**	11.74	**black elderberries**	32.7
grapes	4.48	**corn**	6.66	**blackcurrants**	154.66
fennel	12.00	**rice**	0.00	**sorrel**	48.00
blackberries	21.00	**redcurrants**	37.17	**white gooseberries**	37.00

hypoplasia of the teeth of an individual affected by scurvy (H 801), it can be assumed that he became ill in childhood, at about 3.5 to 4 years of age (Vargová *et al.* 2021). This would roughly correspond to the age at which the baby stopped being breastfed and being saturated with vitamin C from breastmilk and switched to a solid diet. However, meat products are very difficult to digest for children under the age of 3 years, although the need for vitamin C is relatively high at this time (*Table 2*). Beranová (2007) considers this fact to be one of the main reasons for the high mortality of children in prehistoric hunting communities. In addition, the meat of the vast majority of animals does not contain vitamin C at all (*Table 3*). The exception is the guts, especially the liver and kidneys, which, however, had to be consumed fresh and could not be stored for a long time. Thus, avitaminoses occurred mainly during long winters, when there were not enough game animals or plant food.

Kolín

Another osteological collection was dated to 2000–1750 BC and came from the burial ground of the Únětice culture in Kolín (*Figure 2*). Of the collected skeletal remains, only 53 skeletons were evaluable (10 males, 18 females, 9 indeterminate adults, 4 juveniles and 12 children). Manifestations of scurvy were recorded on the skeleton of a 3- to 4-year-old child (accession No. 4330; prevalence of scurvy – 1.9 %). These include the *cribra orbitalia* of II degree, and arborization of the grooves of the meningeal arteries on most of the bones of the cranial vault (*Figure 4*). There were also lodgments of newly formed bone tissue on a number of bones in the postcranial skeleton, such as fragments of ribs, the right scapula, both humeri, the left femur and the left fibula (Vargová, Vymazalová 2022).

In the Early Bronze Age, as the burial ground of the Únětice culture in Kolín (2000–1750 BC) is dated, agriculture was already very widespread in the Czech Lands. The locality is on the Elbe River in the fertile Polabí lowlands, so it can be assumed that agricultural activities could have done well here. However, it is possible that the local population could have been threatened by floods from time to time. According to archaeobotanical research, emmer wheat (*Triticum dicoccon*) was the dominant crop in the Czech Lands at the time. In addition, einkorn (*Triticum monococcum*) was grown to a lesser extent (approximately 2:1) and also spelt (*Triticum spelta*) more rarely, and barley. All these cereals are very undemanding to climatic conditions and soil quality. Among other things, they also show high resistance to weeds and diseases and do not need much care or cultivation (Kočár, Dreslerová 2010). Similar crops were also grown, for example, by

the people of the Únětice culture from Mikulovice (Kočár, Kočárová 2020). It is not known exactly in what form the inhabitants of Kolín consumed cereals. Based on findings from other archaeological sites of older dating (for example, from the Twann settlement in Switzerland, dated to the Paleolithic to Mesolithic), it can be assumed that they could have eaten fresh or roasted whole grains and could have obtained flour by crushing the grain and cleaning it. They then made mash from the flour, by adding water, and fresh or sour milk, or made pancakes or lumps - primitive bread (Beranová 2007). In addition to cereals, legumes, especially lentils and peas, were grown very early in history. Although they had lower yields than grain, they reduced the demands on fertilization, and straw could be used as a good feed (Kočár, Dreslerová 2010). From the point of view of the possibility of scurvy, it is important that legumes contain vitamin C (*Table 4*).

Consumption of other plants can be considered on the basis of findings of plant residues from various Únětice burial grounds in the Czech Republic, Germany and Poland, where almost 40 plant species have been recorded (Pokutta 2014). These include horseradish (*Armoracia rusticana*), garlic (*Allium sativum*), fennel (*Foeniculum vulgare*), cranberries (*Vaccinium oxycoccos*), raspberries (*Rubus idaeus*), sorrel (*Rumex acetosella*), pansy (*Viola arvensis*) and black elderberry (*Sambucus nigra*). The black elderberry, which was detected, for example, in the cemetery in Prague-Miškovice (Ernée *et al.* 2007), is richly inhabited by yeast and could therefore perhaps have been used for the production of sourdough bread, beer or wine. In connection with the high content of vitamin C, it is also possible to point out the white goosefoot (*Chenopodium album*), which was found, for example, in the cemetery in Brandýs nad Labem (Danielisová *et al.* 2013).

In the Early Bronze Age, domestic animals were already bred in the Czech Lands, especially cattle and later also domestic pigs. Skeletal remains of other animals (sheep and goats) are found less frequently at archaeological sites from this period (Kyselý 2020). Horses were relatively rare and were consumed only rarely when there was a shortage of other food. Dogs were also not a regular part of the diet. Poultry was not commonly bred at this time. Consumption of game animals was around 2-10 % throughout prehistoric times, but it was no longer the main food item. In summary, it can be stated that, since prehistoric times, farmers have eaten cereals, legumes, and from spring to autumn various herbs, vegetables, fresh and dried fruits. In the winter, they consumed everything that could be stored for a long time. The domestication of animals enabled them to consume meat, milk, dairy products, cottage cheese and cheese all year round (Beranová 2007). From this point of view, it can be assumed that the main sources of vitamin C for Kolín inhabitants were legumes, guts, milk and dairy products (*Tables 3-4*). From the available natural sources, from the surrounding floodplain forests and meadows, some wild herbs, vegetables and fruit, or forest crops (strawberries, raspberries, etc.) contained vitamin C.

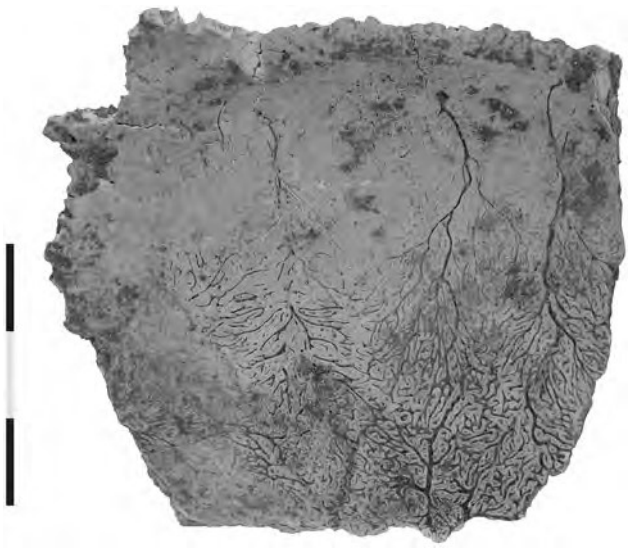

FIGURE 4: Significant arborization of the impressions of the meningeal arteries on the inner surface of the child's parietal bone, which is one of the signs of scurvy on the skulls (child 3-4 years, site Kolín; 2000-1750 BC; object No. 4330; scale: 1 bar = 1 cm, photo by Jana Vachová).

Sady Špitálky

The Sady Špitálky archaeological site (known as "St. Methodius Hill") is located on the southern edge of Uherské Hradiště (*Figure 2*). An extensive sacral complex with a baptistery was discovered here. The unique church building is considered to be the legendary Great Moravian Cathedral, the site of the main work of St. Cyril and Methodius in the Czech Lands. A settlement was discovered north of the brick complex, which also included a Slavic burial ground (Galuška 1996). From the large osteological collection, 27 skeletons (12 males, 11 females, 1 juvenile and 3 children) were studied (dated to the Late Hillfort Period). Scurvy changes were observed on two skeletons (prevalence of scurvy - 7 %). The first of these belonged

to a female about 30–40 years old (grave no. 15/59). In addition to enamel hypoplasia, multiple lodgments of newly formed bone tissue, probably ossified subperiosteal hematomas, were observed on most of the long bones of the lower limbs.

In the second skeleton, male sexual characteristics predominated and belonged to an individual aged 40 to 50 years (no. 122/59). Suspicion of scurvy was expressed on the basis of hypoplasia of the teeth and very significant inflammatory changes around the dental alveoli of the jaws, which resembled a huge *torus maxillaris et mandibularis* (*Figure 5*; Horáčková, Vargová 2014).

The researched burial ground is dated to the Early Middle Ages, when the Czech Lands were part of the Great Moravian Empire and the Slavic population settled here. During this time, agricultural production increased significantly, which allowed a gradual increase in the population. At the same time, however, there was property and social stratification of the Great Moravian society, to which the process of forming the first "State" unit and also the acceptance of Christianity contributed. At this time, fortified Great Moravian forts were built – power, economic and military centers – which, among other things, also represented the seats of the social elites. Fortified settlements mostly had their facilities built in the form of smaller housing estates, which surrounded them and ensured their supply with various products and foodstuffs (Kaupová 2016). Given that the location of Sady-Špitálky is considered to be a center of an ecclesiastical-power character, it can be assumed that the diet here was comparable to the population of fortified settlements. In addition, the analyzed skeletons were selected from graves with rich grave equipment, in which individuals of the upper class were probably buried.

FIGURE 5: Significant bone neoplasia in the form of bumpy formations around the dental alveoli, which arose as a result of chronic inflammatory changes in the periodontium. This is one of the most important symptoms of scurvy (male 40–50 years; site Sady-Špitálky, 9th–10th century; grave No. 122/59; photo by Jana Vachová).

Climatic conditions and the development of agricultural practices provided a wider range of diets at this time than in the past. Legumes, wheat and other crops continued to be grown as in the previous period. Bread, cakes and pirogi were common foods. However, the most popular crop of the ancient Slavs was millet, which was consumed either in the form of porridge or whole cooked grains (Barford 2001, Beranová 2007, Kaupová 2016). Of domestic animals, the Slavs kept mainly cattle. However, the pasture land around the villages was declining, so pig breeding, which was less demanding in terms of breeding space, also expanded considerably. Sheep and goats became a regular part of the herd, but they were not very large in number. Unlike the older periods, the Slavs began to raise hens, as evidenced by the eggs, which in some cases were part of the grave equipment. However, the most important meat consumed by ordinary people was pork, while beef appeared mainly in the diet of the upper classes. Dogs were not normally eaten, only during a famine. Similarly, horses were used only for riding, with their consumption even being forbidden by Pope Gregory III in 732. This was probably followed at such a center of Christianization as was St. Methodius Hill (Beranová 2007).

Taking into account the work of Kaupová (2016), it can be stated that a statistically significant stratification of society had already manifested itself in the nutrition of the Slavs. The socio-economically higher strata (inhabitants of the fortified settlements and probably also the Sady sacral complex) had a larger share of meat in their diet than the economically weaker strata (inhabitants from the settlement facilities or from the countryside). There was also a difference between the sexes. Males consumed more animal protein than females, whose diet was dominated by plant foods, especially millet. At the same time, the duration of breastfeeding was estimated from children's skeletal remains, which ranged from a relatively wide range of 2 to 5 years, with mothers from socially disadvantaged backgrounds breastfeeding for longer.

In the isotopic analysis from bone samples from the Sady osteological collection, it is interesting that the

consumption of ocean fish was recorded here, among other things. The study site is in the middle of the European continent at a point more than 700 km from the nearest Baltic Sea coast (*Figure 1*). Thus, fish from the sea could have been consumed in the important church center as fasting food in the form of herring, smoked or dried fish, or fish traveling from the sea to freshwater streams at the time of reproduction (known as anadromous), such as sturgeon (Nývltová Fišáková 2022).

Thus, the sources of vitamin C in this group of people were similar to the sample of the Únětice culture population (*Tables 2–4*) – legumes, guts of domestic animals, milk, dairy products, vegetables, fruit, herbs, berries. However, their diet was a bit more varied and richer.

Trutmanice

From medieval archaeological sites, scurvy was recorded in the burial ground of the extinct village of Trutmanice, which was located southeast of Velké Pavlovice (South Moravia, *Figure 2*). Based on the funeral equipment (groschen of John of Luxembourg, ceramics, etc.), the site was dated to the 13th to 15th century, i.e. the period of the High Middle Ages (Bíško *et al.* 2019).

The remains of 149 individuals (24 females, 32 males, 23 indeterminate individuals, 70 children) were subjected to a detailed analysis. Typical signs of scurvy were found on the skeleton of a 2- to 3-year-old child from grave no. 884 (prevalence of scurvy – 0.8 %). These were mainly porotic changes on the roof of both orbits (*cribra orbitalia* of the II degree), on all walls of the orbit (especially on the large wings of the sphenoid bone; *Figure 6*), and also around the openings through which the branches of the maxillary artery pass. On the flat bones of the cranial vault, a rich arborization of the impressions of the meningeal arteries was observed, which was deeply immersed in the diploe. A sign of ossified subperiosteal hematomas was marked hyperplasia of the diploe, recorded in places on the cranial vault and periostotic lodgment of newly formed bone tissue on the body of the right tibia (Račanská *et al.* 2023).

Cereals and legumes continued to be grown during the High Middle Ages. However, the flour was no longer ground in hand mills, but in mills. Bread was a common food for the rich and poor (wheat and rye). In the villages, it was usually baked at home, but in the cities, bakers had already started to specialize in the production of bread and other pastries. It was eaten fresh, but also dried, which was usually added to the thickening of soups, etc. Various types of porridge were very popular (from flour, meat, cream, milk, eggs, cheese, with vegetables and fruit, salty and rarely sweet). At this time, flour dumplings were not yet made (the first mentions

FIGURE 6: Characteristic manifestation of scurvy on the child's skull – pitting on the greater wing of the sphenoid bone (child 3–4 years; site Trutmanice; 13th–15th century; grave No. 884; scale =1 cm, photo by Jana Vachová).

of them are from the 16th century). Dumplings were made only from meat, mushrooms, etc. During this period, sweet pastries, such as cakes and gingerbread, also began to be commonly baked (Beranová 2007).

Domestic animals were also bred in the Czech Lands during the High Middle Ages. These were mainly cattle and domestic pigs. Sheep, goats and poultry were bred less often. Game animals were rarely consumed, with the share of game meat in the diet ranging between 1 and 8%. Deer, hares and boars were mainly hunted. Research on animal bones from waste pits with traces of culinary processing from various medieval Moravian archaeological sites revealed that beef of the highest quality (from the rump, shoulder or neck) was then consumed to a greater extent in aristocratic settlements and medieval towns, followed by pork (Páral *et al.* 1994). Beef was rarer among the socially weaker rural population, but pork was commonly eaten in the same amount as in wealthier groups, but of a lower quality (Páral, Pyško 2011). The rural population of Trutmanice was probably no exception. Sources of vitamin C were similar to those in the population from the older period. However, it should be emphasized that the village of Trutmanice was located in Southern Moravia, which is one of the most fertile areas in the Czech Lands. It is famous for growing fruit and vines, foods rich in vitamin C. Archaeological finds in this locality confirm a winery in the 14th century (Nekuda 1982). It should also be emphasized that Czech cuisine in the field of culinary art was considered one of the best in Central Europe in the Middle Ages (Beranová 2007).

Former Brno Municipal Cemetery in Malá Nová Street (present-day Antonínská Street)

The last examined skeletal collection represents the remains of a typical modern urban population from the turn of the 19th century. It comes from the central part of the abolished Municipal Cemetery in Malá Nová Street (present-day Antonínská Street; *Figure 2*) in Brno, which was used in the years 1785–1883 to bury the dead from five Brno parishes (Flodrová 1992).

The skeletal remains of 1 083 individuals (238 male, 208 female, 217 indeterminate adults, 420 children) were studied. Grave pits were mostly used repeatedly for burials, with the degree of preservation of individual skeletons and their parts varying considerably (Merta 1999). During the paleopathological analysis of this skeletal collection, possible signs of scurvy were found on two children's skeletons (prevalence of scurvy – 0.2 %). In the first case, they were observed on the skeleton of a 4- to 5-year-old child (grave no. A 867), where, in addition to enamel hypoplasia, variously large areas of newly formed bone tissue with a rough surface and fine perforations were found on the surface of most preserved bones of the postcranial skeleton (fragments of ribs, left scapula, both humeri, left pelvic bone and right tibia; *Figure 7*). A similar finding was recorded on fragments of the femoral diaphysis of a 1- to 1.5-year-old child from grave no. A 829. The lesions were only on the surface of the bones; the deeper structures showed no changes. In this case, it was not possible to evaluate any traces of scurvy on the skull, because it was not preserved (Vargová, Horáčková 2006).

FIGURE 7: The inner surface of the left scapula with the plates of newly formed bone tissue. It is a remnant of ossified subperiosteal hematomas, which is one of the typical signs of scurvy on the postcranial skeleton (child 4–5 years; site Brno-Malá Nová Street; 18th–19th century; grave No. A 867; scale=1 cm, photo by Jana Vachová).

The diet of the Brno population of the 18th and 19th centuries differed according to the social structure of society. The upper and middle classes were represented by burghers, nobles and officials; the socially weak group were day laborers, service staff and workers in the newly emerging factories (Vargová *et al.* 2010).

A burgher's family diet consisted of breakfast, lunch, and dinner. They consumed milk and bread, or bread and cheese, or bacon, smoked meat, ham or cold roast leftovers for breakfast. The porridge was cooked, millet, semolina, buckwheat, and later corn. They could also have breakfast of soup made of milk, whey, beer or wine. Lunch in burgher families usually comprised six courses: soup, made of beef (usually with sauce), "appetizer" (vegetables, fruit, legumes), cooked meat, roasts (without significant side dishes) and dessert, or heat-treated salad or stewed fruit. However, the total quantity of food was not large, because the portions of the individual courses were small. It was not until the end of the 19th century that buns and side dishes (for example, in the form of dumplings) appeared in the diet and this trend continued in the following centuries. Not much fat was used in the food preparation; the food was varied with plenty of vegetables. During Lent, meat dishes were replaced by meals of eggs, fish, crayfish, frogs and snails. Fish or pea soup was cooked instead of beef soup. Dinners, with the exception of banquets, were also simple and less nutritious than those of today. Bread and cheese, bread and butter, or jam, toasted bread with cheese and fried onions were usually eaten. However, soup or porridge could also be eaten for dinner, as for breakfast. Dinner was early, around 5 p.m. There was a regular fast every Friday, and in addition, there were many other fasting days according to the Church calendar during the year. Compared to the Middle Ages, however, they were fewer in number and the rules were not so strictly followed (Vargová *et al.* 2010).

It was not until the first half of the 19th century that a significant change in diet came about, and potatoes began to be consumed in the Czech Lands. Although they had appeared here before, they had been grown in gardens as ornamental plants. Potatoes were first used to feed cattle, to produce alcohol, and, even during the years of grain crops, to make flour. It was not until the first half of the 19th century that potatoes began to be consumed in large quantities (Vargová *et al.* 2010).

The diet of the burghers was to some extent also subject to seasonal changes. In January, meat (beef, veal, mutton, pork, game), fish (mostly carp, pike, perch), oysters and snails, as well as dried and pickled vegetables and dried fruits of all kinds were especially consumed. In the month of March, young hares and poultry were added to the diet, as well as tiddlers, frogs and early vegetables (for example, spinach and asparagus). In May, the diet was expanded mainly to fresh vegetables and crayfish. In September, other birds (woodcocks, thrushes, fieldfares, larks, chaffinches, titmice), seasonal vegetables and fruits (grapes, peaches, apples) enriched the diet. Dried fruits and vegetables were stored for the winter months (Vargová *et al.* 2010).

From the second half of the 19th century, the number of lunch courses decreased to four, at the turn of the 20th century to three (soup, main course with or without meat, dessert). In starting to save on meat, more flour and potato side dishes were appearing. Due to the growing employment of women in cities, food preparation in households became simpler and faster. The city began to lack food ingredients that the villagers themselves grew or collected. Lower sugar and flour prices led to the more frequent preparation of hearty, sweet, flour meals. However, only those who had sufficient funds ate in this way (Vargová *et al.* 2010).

However, the diet of Brno's working-class families in the second half of the 18th and the first half of the 19th century was different. Potatoes, prepared in various ways, made up a significant part of the diet. Breakfast was soup (most often potato, then caraway, garlic or fried), with which bread was eaten. It was not until the second half of the 19th century that soup was replaced by coffee brewed from various substitutes, and occasionally also from coffee beans. Lunch was based on potatoes used in the soup, but mainly cooked as a complementary dish. Dumplings were prepared from potato dough, sprinkled with poppy seeds, there were noodles, dumplings topped with boiled plum butter instead of grease, pancakes, potato gnocchi and dumplings with plenty of fruit. Leavened or bread dumplings were prepared only for festive lunches on Sundays or on festive occasions. Sauerkraut, which was a cheap source of vitamins, was widely used in the winter months. In addition to potatoes, legumes were used to prepare lunch. Soup was cooked from them, which was often the only lunch; otherwise porridge was prepared from these legumes, again supplemented with potatoes. Meat was rarely cooked for lunch; usually it was beef, less often, pork or veal. Large buns filled with peppered stewed carrots or cabbage were baked from the leavened dough. For dinner, there was again soup, boiled potatoes with goat's milk, later coffee and bread (Vargová *et al.* 2010).

A worker's diet was completely dependent on earnings, which were often insufficient for large working-class families, so the quantity and composition of the

food were unsatisfactory. The food of the poorest in the city and in the countryside was very simple. Meat became a festive meal, usually appearing on the menu on Thursdays and Sundays. Soup (semolina, bread, potato) was served for breakfast. Coffee (from substitutes) began to appear, complemented by bread. Lunch consisted of two courses: soup and main course, such as buttered peas, mashed potatoes, mutton with rice (on Thursdays), dumplings and cabbage, groats. There would be bread, cheese, beer, or leftovers from lunch for dinner (Vargová *et al.* 2010).

During this period, the first canteens were also established in factories, where workers could pay for a full-course meal, which not everyone could afford. Many workers therefore took food from home to work every day. Roasted white pudding, black pudding and sausages started to be sold in breweries and inns, so that the more affluent Brno residents were increasingly eating out (Vargová *et al.* 2010).

Taking into account the above diet, it can be stated that the upper and middle classes of the Brno population had a very varied selection of food and were therefore not threatened by scurvy. Among the poorest workers, the most important prevention of the disease can be considered the relatively frequent consumption of legumes, cabbage and especially potatoes.

Contemporary literary sources also document the "epidemic" occurrence of scurvy in orphanages and foundling homes, where undoubtedly a very poor diet caused by the poverty of the institutions, which operated only with the financial support of charities, contributed to its cause (Duchek 1873). At this time, when the Czech Lands were part of the Austrian monarchy, namely of Maria Theresa and subsequently of Emperor Joseph II, they sought to establish and support these institutions, but the high mortality and morbidity of the children placed here testified to the poor living conditions. In addition, the orphanages and foundling homes were social rather than medical institutions. In Brno, however, they were part of a caregiving institute, which was actually the first public medical facility in Brno, later renamed as St. Anne's Hospital (Vargová *et al.* 2010).

TABLE 5: Number of hospitalized males with scurvy in the Monastery Hospital of the Merciful Brothers in Brno.

Year	Scurvy			Total hospitalized
	Number of scurvy cases	Number of healed	Number of deaths	
1848	1	1	0	1041
1849	3	3	0	999
1850	1	1	0	1038
1896	1	1	0	1416
1898	0	0	0	1396
1899	2	1	1	1383
1901	1	1	0	1266
1903	0	0	0	1568
1907	0	0	0	1468
1910	0	0	0	962
1911	0	0	0	1514
1912	0	0	0	1536
1914	0	0	0	1171

For this reason, it is possible that the described cases of scurvy in children buried in the former Municipal Cemetery in Brno, which represent less than 0.5 % (n = 440) of the examined child population, were inmates of social institutions.

According to written sources, another group affected by scurvy was soldiers, especially during wartime (Duchek 1873). It can be assumed that this was also the case in the local Austrian Army. However, paleopathological finds of skeletons of soldiers with scurvy changes from Czech and Moravian archaeological sites have not yet been recorded, not even on the remains of soldiers from mass graves killed in the Battle of Austerlitz in 1805 (Horáčková, Vargová 1999, Vymazalová *et al.* 2021). The data on the Brno military hospital are also fragmentary; either they have not been preserved or they have not been published for strategic reasons. Mass military burial grounds here have not yet been studied from a paleopathological point of view. Partial information on the occurrence of scurvy in a sample of the male population could be obtained on the basis of a study of the reports of hospitalized patients in the male Monastery Hospital of the Merciful Brothers in Brno in the period 1848–1914 (Moravský zemský archiv Brno, 1848–1914). From this time, the reports of 13 years were available (*Table 5*). A total of 16 758 patients were treated, of whom only nine (i.e. 0.05 %) were hospitalized for scurvy. Almost all were cured and released, only one died of scurvy. From the above data, it is clear that scurvy was not as common in the Czech Lands as in coastal countries. Wartime events and starvation were confirmed as supporting the occurrence of avitaminoses, as the largest number of cases of scurvy (5 in total) was recorded in the turbulent years of 1848, 1849 and 1850. On the contrary, after 1901, no patient had to be hospitalized due to scurvy.

In addition to foundling homes, orphanages and soldiers, the mass occurrence of scurvy in the 18th and 19th centuries was also described among prisoners in the Brno dungeons, which included especially Špilberk Fortress. During the reign of Emperor Joseph II, Špilberk was one of the toughest prisons of the Habsburg monarchy for the worst offenders (murderers, robbers, arsonists) with sentences of more than eight years. In the 1830s, Italian Carbonari were also imprisoned here for political crimes against the Austrian monarchy. There was a prison hospital right in the fortress, attended twice weekly by a doctor and a healer. Very brief information about the patients was recorded in the weekly reports. The patients' diet was in the hands of the doctor. He recommended dosages and better diets, but each proposal was submitted to his superiors, so that, as part of austerity measures, patients would receive better food only for the necessary time. At the request of the prison doctor, prisoners sentenced to life imprisonment from 1786 onwards received prescribed doses of sauerkraut for scurvy prevention (Horáčková *et al.* 2007). It is certain from this regulation that the lack of vitamin C was a significant threat to convicts in Špilberk, although it has not yet been possible to obtain direct evidence on the basis of paleopathological research.

According to contemporary literature, cabbage was used to treat scurvy among the civilian population, as well as herbal juice and sprouted peas (Nopp 1926).

CONCLUSIONS

From the above-mentioned literary and paleopathological findings, it is clear that even in the Czech Lands located in Central Europe in a temperate climatic zone and surrounded by the mainland, there have been cases of scurvy since prehistoric times. In connection with the eating habits, hunters and gatherers (see Podivín site) were most at risk of avitaminosis C among prehistoric groups during the extremely long winters, especially before the beginning of spring. In the winter months, there was mostly a shortage of both meat and especially of plant food. The method of distribution of the catch among individuals within the group could also affect the disease. Consumption of game, which contains vitamin C only in the guts, predominated. Thus, the main source of vitamin C for hunters and gatherers was various herbs, berries, or wild fruits. In addition to climatic conditions, the content of vitamin C in food also depended on the heat treatment of the food, or on its preservation, e.g. by drying.

The beginning and subsequent development of agricultural activity in the Eneolithic period brought about a significant change in the diet of the inhabitants of the Czech Lands. In the Early Bronze Age, as shown by a study from the period of the Únětice culture of the Kolín site, cereals (emmer wheat, einkorn, spelt), legumes (lentils, peas) and various herbs, vegetables, fresh and dried fruit predominated in farmers' diets. In the winter, they consumed everything that could be stored for a long time. The domestication of animals enabled them to consume meat, milk, dairy products, cottage cheese and cheese all year round (Beranová 2007). The main sources of vitamin C were legumes, guts, milk and dairy products. Of the available natural

resources, wild herbs, vegetables, wild fruits and forest crops (strawberries, raspberries, etc.) were important.

In the Early Middle Ages, the Slavic population settled in the Czech Lands (see the site Sady Špitálky. During this time, agricultural production increased significantly, which made it possible to grow other crops. Apart from legumes and wheat, millet had become the most popular Slavic crop. Cattle were bred, but pig breeding expanded significantly and the popularity of pork increased. Poultry began to be raised, mainly due to the consumption of eggs. At this time, there was a gradual social stratification of society, which led to differences in the diet of rich and poor residents. Slavic fortified settlements were power centers, well supplied with various types of food. The diet was varied, so the inhabitants were not at risk of vitamin defects. Village populations, creating the background of the settlements, had a simple diet with a smaller proportion of meat. However, favorable climatic conditions made it possible to obtain vitamin C, among other things, also from natural sources – from forest crops, wild herbs, etc.

The situation was similar for the rural population during the High Middle Ages, as can be seen from research at the site of the extinct village of Trutmanice. Cereals and legumes continued to be grown. Sources of vitamin C were similar to those in older populations, but in addition, fruit began to be cultivated and grapevines grown in the Czech Lands. Culinary art developed significantly, with Czech cuisine at this time being considered one of the best in Central Europe. According to contemporary literary sources and on the basis of paleopathological findings, it is clear that modern society, especially the urban population, was most at risk from scurvy (see the site of the former Municipal Cemetery in Brno). Military conflicts in Europe had caused extreme poverty and an unprecedented increase in war invalids and orphans among the socially disadvantaged. These individuals then remained dependent on the aid of humanitarian institutions – poorhouses, foundling homes and orphanages. These facilities mostly had financial problems and were unable to provide adequate nutrition for the inmates, as they relied mainly on charitable assistance. For this reason, scurvy occurred there. Another mass occurrence of scurvy due to insufficient intake of quality food was also reported in prisons and the military (Nopp 1926). Cabbage, herbal juice and sprouted peas were used as antiscorbutic drugs.

Other inhabitants of cities were mostly not at risk of scurvy, because the upper and middle classes had a diet rich in vegetables and fruit. The socially weak group (workers, maids, minor craftsmen) in turn regularly consumed potatoes or dishes made from potatoes. Although the content of vitamin C in potatoes is not very high (*Table 4*), their regular intake in sufficient quantities was enough to protect against scurvy. The low incidence of scurvy is also confirmed by regular reports from monasteries and public hospitals (*Table 5*).

The rural population also did not normally suffer from scurvy, as it had better access to natural sources of vitamin C (forest fruits, wild herbs, etc.).

It is interesting that, in all historical periods in the Czech Lands, people did not eat horse or dog meat. These animals served humans in their daily activities and were consumed only in exceptional cases, in times of war and famine. The bones of dogs and horses with traces of culinary processing are unique in archaeological research.

In this context, it should be emphasized that scurvy may not only be caused by insufficient intake of vitamin C in the diet, but also by an increased need of vitamin C, for example in infectious diseases. Malabsorption syndrome (disorders of food intake and absorption of vitamins and nutrients by the intestinal mucosa, for example, in celiac disease) and genetic predisposition may also be involved (Delanghe *et al.* 2013, Krenz-Niedbala 2017).

The presented study, in agreement with various authors (e.g. Brickley, Yves 2008, Krenz-Niedbala 2017, Mays 2014, Stark 2014), as well as contemporary literary sources (e.g. Duchek 1873), confirm that scurvy among the civilian population endangered children especially in all historical periods. This is also evidenced by the findings of scurvy manifestations on some adult skeletons (see the skeleton of a male from grave 801 in the Podivín site), where hypoplastic grooves on tooth enamel allow the estimation of tooth defects and thus diseases in early childhood. At the same time, it is possible to confirm the assumptions (e.g. Lewis 2017, Rebay-Salisbury *et al.* 2018) that the occurrence of scurvy in children between the ages of 2 and 5 years is closely related to the termination of breastfeeding and the conversion to solid food. At that time, children were given mainly milk porridge, which had insufficient amounts of vitamin C, at a time when their need was almost constantly growing (*Table 2*).

Paleopathological findings of scurvy in the Czech Lands agree with the results of studies by Brickley and Yves (2008), Krenz-Niedbala (2017) and Mays (2014). The disproportion between the described higher occurrence of scurvy in literary sources and the relatively small amount of direct paleopathological evidence may have a number of causes. In particular, most of the

skeletal remains of historical populations from the Czech Lands have not yet been subjected to a detailed paleopathological analysis. Furthermore, fragile, pathologically altered children's skeletons have not been preserved in osteological collections. In addition, the initial stages of the disease, which probably prevailed in the temperate zone of the Czech Lands in the past, first appear on the soft tissues, and bone damage is evident only in the advanced stage of avitaminosis C.

However, the most important factor is probably the relatively difficult diagnosis of metabolic diseases in paleopathology (Snoddy *et al.* 2018), so some manifestations of scurvy may have remained hidden under other diagnoses (e.g. *cribra cranii*, *cribra orbitalia*, anemia, periodontal disease, meningitis, periostosis, etc.). Therefore, the diagnostic criteria of scurvy were described in the professional paleopathological literature much later than in other types of diseases. It can be assumed that, in the following period, further paleopathological studies of historical skeletal remains will gradually supplement the current list of skeletons with manifestations of scurvy in the Czech Lands.

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